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## HANS-DIETER BAHR AND THE HANDLING OF MACHINES

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In the course of the industrial use of electricity and the emergence of new communication and transport technologies and routes (including their partial nationalization), the gradual process of the dissolution of the classical machinery of the industrial age, or at least its integration into new contexts, began towards the end of the 19th century. Traffic and transportation routes are expanded due to the emergence of new energy generation and distribution complexes; the driving machines increasingly operate as independent power plants, and finally the individual factory reverts to the status of a machine tool. Production processes are controlled internally and externally through the use of measuring instruments

from low-current technology, through the mechanization of language and semiotics and their diagrams.

Bahr ascribes to the chemo-technical industry (in Germany) at the beginning of the 20th century the function of enabling and finally realizing the first integrative combination of machinery and scientific apparatus, whereby new measuring instruments and new materialized rules control the production process, which is held together by “conduit, container and other structuring systems, by chemical substance conversion reactions and mechanical forms of transport of the resulting product”. (Bahr 1973: 54) In the chemical industry, in which not only given substances are treated, but also qualitatively new substances are generated (metals and cloth are now produced synthetically), there is also an ever stronger co-development between a field of engineering that is still based on experience and a laboratory-oriented scientific dispositive. Bahr describes the scientification of production as an ideal socialization.<sup>1</sup> The scientific inventions and theories of Faraday and Maxwell already indicate a development that is increasingly moving from science to industry. Finally, it should be noted that the replacement of human energy by the harnessing of fossil fuels was a decisive factor in the development of capital in the 20th century. From the 1950s onwards, qualitatively new internal relations of the machinery emerged, i.e. its integration into electronic-digital networks, which today are regulated and controlled by polystructural algorithms, operating in symbolic, real structures in order to perpetuate and stage the relative surplus value of capital, a differential surplus value that can no longer be easily localized at a specific point in the machine complex itself or in its relations (differences of intensification, of productivity).

In general, it can be assumed that the data of the natural sciences – their measured values – are the result of a practice mediated by measuring instruments/apparatus. These material-discursive practices in turn incorporate the functional norms of measuring instruments, which are based on the expectability and reproducibility of measured values. (Cf. Schlaudt 2014a: 69) The accuracy of the experiment depends on the precision of the measuring instruments, which in turn incorporate mathematical, hypothetical and theoretical elements in order to ultimately arrive at an analysis of the measured material or machine activity by conducting the experiment. In this context, heterogeneous measuring instruments can be assumed, which lead to different concepts of size in specific historical situations, insofar as they are related to very specific phenomena. The use of measuring machines leads to a kind of reversal of the machine tools, because here an external material is no longer processed by the machine, but rather an external instrument now measures the machines (and their processes), i.e. records their respective states as data. (Bahr 1983: 224) In this context, mechanization means presenting any type of machine as the precision of a mechanical process that proves to be a measurement. A label, a measure, is now attached to the machines. (Reference should be made here to instruments for measuring lengths and areas, to measures of weight, to the telescope and the compass, to the number and finally to the measure of all measures, money). However, there is no general matrix for all concepts of size, such as a pure quantity or “quantity in abstracto” – a term that can be found in Sohn-Rethel (Sohn-Rethel 1970: 55f.) – at most it can be said that money dominates as an ideal external measure with regard to quantification in capitalism. (ibid.: 97) From the outset, the innovations regarding a new way of seeing and knowing promise a new quantitativism whose motto is: reduce reality to what can

be counted and count the quanta. This quantitative reductionism is closely linked to a transformed space that can be viewed from the outside.

The relation between the already monetarily defined constant capital and the objective structure of the machine, which Bahr refers to as the “inner value form” of the machine, is not based on an immediate mapping connection or a direct causal relationship; rather, this relation must first be “mediated” through the technical-experimental production of sensual measures of the machines.<sup>2</sup>

Bahr thus makes an analytical distinction between machinery as constant capital, which is already defined in monetary terms (purchased in order to be used in production processes), and machinery as the mode of existence that is materially adequate to capital. This requires a specific structuring/formation, which is not at all alien to Marx when, in addition to the first aspect of machinery, he also considers the use-value structuring aspect when he writes, for example: “But it is only since the introduction of machinery that the worker fights the means of labor itself, the material mode of existence of capital.” (MEW 23: 451) It is precisely this second aspect that Bahr is concerned with in his early studies on the capital-machinery. It is implicit in this that capitalist machinery is by no means a neutral means of dominating nature, as if, after a revolution, it were perhaps only a matter of applying the machinery correctly in order to drive technical progress towards socialism.<sup>3</sup>

Bahr makes a distinction in his essay *Die Klassenstruktur der Maschinerie. Note on the Form of Value* from 1973, Bahr initially distinguishes between the term “Zweckgemäßheit”, which refers to the receptivity of natural substances, and the term “Zweckmäßigkeit”, which emphasizes technology as a means to ends (of capital). This difference is not immediately apparent. Thus, on the one hand, machinery is expedient, it is a material raw material or form for something else, and on the other hand it is expedient, i.e. its construction is an immanent social form, which Bahr calls the “use-value form” or “natural form of capital”. This, in turn, has a double form: firstly, as constant capital, the machinery shows purely formal expediency with regard to the appropriateness of pure functioning or uninterrupted movement, and this appropriateness remains related to the effectuation of economic purposes. (Bahr 1973: 58) As a means of labor, it is already a means for the production of relative surplus value. The form of capital *sui generis* adheres to its shape, and thus its state of rest can only be an expression of the economic crisis or its natural or moral wear and tear. Secondly, in addition to its form as constant capital, machinery possesses a specific use-value form whose function is to be able to produce use-values as commodities at any time, if the purposes of capital so require. We can therefore assume a twofold doubling of the machine. Firstly, the doubling into natural form and social form and, secondly, its doubling into value form (constant capital) and use-value form. It is precisely this folding that Bahr calls the class structure of the machine. (ibid.: 62f.) Later, Bahr replaces the term “use-value form” with “natural form of capital” and distinguishes the ideal forms of thought from the latter. As a kind of intermediate instance, technology/machinery is by no means to be understood as the result of purpose-rational action or the thinking of subjects, just as, on the other hand, it is not a mode of nature that could then be thought of as the prosthesis of a corporeal body, for example; rather, machinery incorporates the objectified purpose of capital, which means that it cannot be a purely neutral instrument. The relative surplus-value production of capital is constitutive of this kind of

objectification, which tends to accelerate the replacement of variable capital by constant capital.

Both the ideal forms of thought and the machine forms of nature are absolutely necessary for the utilization of capital. In his above-mentioned essay, Bahr attempts to define the ideal forms of thought in a rather functionalist manner as constitutive parts of the economic functional areas of production and circulation, and this means asking about the rules of their distribution, communicability and materialization. For Bahr, issues such as pricing, natural sciences, accounting and, to some extent, the value form/natural form of machinery can be subsumed under the forms of thought. Theoretical categories, the mathematics of economics and even the sensory measures of machinery can also be regarded here as parts of the ideal forms of thought. These forms of thought accelerate the unification of the production processes of capital, which definitely require theoretical operations such as calculation, planning and calculation in order to inscribe linear time, continuity and uniform movement into the production processes. With this inscription of sensory measures into the machinery, the ideal form of thought is transformed into an objective form or the material mode of existence of capital. The value form thus enters directly into production, i.e. the machinery takes on an inner value form.

However, the intrinsic form of value or the sensory measures initially arise from the form determinations of circulation and exchange (measures of weight and number are constitutive for exchange, even if they are secondary to money; *ibid.*: 64) In part, sensory measures (measures of weight) served as special forms of equivalence in pre-capitalist societies, which, however, could not develop into money as the external measure of commodity values. Scales and metal weights were part of an unfinished development of weight money, because not all interchangeable things could be related to each other by weight. However, the objects retained their standardization qua unit of measurement and this was sufficient for these units of measurement to function as a secondary condition for exchange value, which always remained tied to money. With regard to products as quantified quantities, Bahr essentially speaks of four units of measurement, which are to be regarded as special forms of equivalence, but which could not serve as a central measure like incorporeal money in the first place because they were bound to the bodies of the products: Space-, time-, weight- and number-measure (primal meter, primal time, primal kilogram and the number system) – the latter may be regarded as a pure determination of size, as the most “abstract” measure, with which, among other things, universally valid communicability becomes possible. (Bahr 1983: 390) Measures are divisible, i.e. their units of measurement allow for certain quantities, and these are intelligible insofar as they can be treated as signs. In the exchange mediated by money, the central measure is already present, i.e. money compares the products neutralized in this way, which at the same time have sensual measures in themselves. (Value quantities actually only exist at the level of total capital).

As potential commodities, specific measures are assigned to the products, i.e. as exchange values, commodities are each already in specific quantities: 20 cubits of canvas are worth 1 skirt. Here, a certain quantity of the length of the canvas is equated with a certain number of skirts. From this perspective, Marx considered the exchange value form “x commodity A = y commodity B” as follows: “x shares of measure x’ (commodity A) = y shares of measure y’

(commodity B).” Even the simple value form thus equates two different sensory measures; they are to be understood as a specific parergonal structure that is related to the exchange value quantified by money, which is articulated per se in the price ratios of two commodities (the quantity of another commodity for which a given commodity can be exchanged).<sup>4</sup> Bahr comes to the conclusion that two “social” relationships must exist, the sensory measures of commodities and money, at the latest with the establishment of the general value form.

According to Bahr, the concrete determination of the various sensory measures first occurs in circulation. Capitalist companies produce specific quantities of products for the market once they have established certain economic relations, and this is what Bahr calls the form of determinability of quantities. Due to their previous market experience, companies always produce calculated, i.e. relatively exact quantities of products, and thus the sensory measures inevitably migrate into production. (Cf. Bahr 1973: 66) This also happens because the goods, which already have sensory measurements, are returned to production through their sale or realization in circulation. Once this cycle has been established, the sensual measures must necessarily also be included in the determination of the machinery – its units of measurement or measures are signs that adhere to such machines, which “mediate” themselves, the raw materials and the labor force with each other qua uniform movement, technical control and time measurement. Under certain circumstances, a company produces only that part of a product which, as a calculated unit, requires sensory measurements in order to be assembled into a complete product in further production processes, whereby repeatable composability or modulation into a single product must be guaranteed by certain measurements. (ibid.: 63) The determination of the quantities of goods qua sensory measures is thus already co-produced in the production process. In the early 1970s, Bahr was probably the first author in the Marxist context to speak of the “intrinsic value form of the machinery” or the “natural form of capital”.

He then asks how the inner value form of the machinery could become constitutive for production and how the forms of thought helped to shape this development process. For its material production processes, capital requires specifically formed means of production that are carriers of constant capital, while the labor power produced remains a carrier of variable capital. According to Bahr, it is decisive for the question that the machinery in its objective and structural moments takes on an inner value form, i.e. the machinery incarnates capital in its logic and class structure. From a certain stage onwards, the already capital-infected machinery enables the further determination of forms of thought. In this way, experiment and the theoretical natural sciences are also related to each other via the machinery or apparatus, and this type of mediation between science and machinery finally becomes established with the second wave of industrialization at the beginning of the 20th century (chemical industry and electrical industry). Woesler criticizes Bahr at this point because he assumes that, on the one hand, the forms of thought were directly incorporated into the machinery, but that, on the other hand, these were created precisely in the separation of industrial production processes and that Bahr was unable to convey this problem. (Cf. Woesler 1978: 187)

Today, certain measurements are recognized as basic measurements in research and its laboratories, and electrical and chemical engineering are constantly generating new, artificial units of measurement. These measures and units of measurement form the condition for the

possibility of uniform industrial standards that are directly linked to the intrinsic value form of the machinery. (Cf. Bahr 1973: 64) The uniformity of the production processes absolutely requires this standardization in order to guarantee the homogenizing technical constructions of the products and the linear process sequences of the machines. This type of production continues into modular construction, the assembly of standardized and recombining parts on the basis of a prefabricated material. Bahr defines the industrial standard of the individual machine part as the appropriated and objectified form of the general interchangeability of products, and here, too, mediality is immediately apparent. In today's world of barcodes and RFID tags, we see that it is not only a matter of classifying, measuring and selling products, but also of finding out where they are at any given time within the global just-in-time management regime. This applies to goods as well as people. We are all commodified, packaged in digital packages that are transported through certain time regimes of control and management.

The structure of use value in terms of measurements – weight, length, hour or the intelligible form of number – must be set off against the immediate use value that satisfies a need, whereby the number in particular – alongside money – makes it possible for us to speak of the general ability of machines to communicate at all. If we assume that the properties of machines require measurements for their communicability, then other machines must inevitably be produced that coordinate and measure speeds, construction, process and material properties, wear, consumption, etc. (Bahr 1983: 407). (Bahr 1983: 407) Today, measurements require certain digital measuring devices and corresponding axiomatic systems, diagrams, algorithms, etc. Standardized measurements are used as industrial standards in the manufacture of machines. And the procedures of the money calculating machines are in turn linked to these sensory measurements or, to put it another way, if machines today produce the conditions of their social communicability themselves (especially qua a-significant semiotics), then the price and money calculating machines can connect to them as abstract communication machines whose performance is in turn quantitatively determined (the mathematics of economics). In his book *Über den Umgang mit Maschinen*, Bahr describes the price as a “war machine” sui generis. (ibid.: 407)

One can summarize with Bahr at this point: Under conditions of capital, the natural material of commodity bodies must not only assume purposeful form for use, but also purposeful form for exchange, which in turn functions as the function co-produced by capital, whereby it is primarily in production that the constitution of adequate use-value forms of products takes place. (ibid.: 64) From this it can be concluded that the structural use-value form or the natural form of capital corresponds to the uniform movement in the mechanical production of capital. We should therefore speak of an entity “machinery” that has a specific form and temporal form of movement and is at the same time a means of valorization, constant capital. In his essay *Die Klassenstruktur der Maschinerie*. Note on the value form, Bahr pointed out that under capitalist conditions, machinery is also permeated in its “material structure” by the mode of the capital relation, which from the outset removes the ground from any labor ontology (of which Bahr also discovers numerous traces in Marx). It is again Christine Woesler who, in one of the few theoretical discussions of Bahr's theses, points out that he overestimated the importance of sensory measures for the determination of machinery, whose real determining factors are rather uniform movement and the measurement of time.

(Woesler 1978: 317)

The connection between machinery, capital and natural science in Bahr's context needs to be presented very briefly: Bahr speaks of the original principle of form underlying theoretical mechanics and the division of labour (geometric, uniform, self-sustaining motion), but definitely emphasizes the disparate development between theoretical mechanics and the various practices of production. Interference between the two areas can only occur when a machinery that has become discursive has completely detached itself from the function that lies in the reinforcement of organ activity and translates mathematical-logical knowledge into production as an objective technique. It should be noted that mathematics does not translate itself one-to-one into production, as it does not maintain a direct relationship to the object as the object of analysis.

In his later work *Über den Umgang mit Maschinen*, which we will come to in a moment, Bahr clearly distances himself from Sohn-Rethel's attempt (Sohn Rethel 1970) to derive the forms of thought from the exchange of commodities mediated by money and the real abstraction supposedly inherent in this, since such a procedure always presupposes what is actually to be derived. To present this problem briefly: The forms of thought result from the exchange mediated by money, whereby the real abstraction is indeed indicated, but the problem of the mediation between exchange and the form of thought is just named, so that Sohn-Rethel, in order to arrive at the abstraction of thought, must interpose an act of identification, reflection and inversion between the commodity form and the form of thought. With regard to the derivation of the concepts of understanding (as a substitute for Kant's transcendental deductions), Sohn-Rethel notes a kind of identification of the agents with the abstract, quantitative nature of money, which had not escaped the attention of the Greeks. With regard to the concept of reflection, it must be said that the reflection of a form in another medium presupposes the intellect, which compares the reflected forms with each other in order to arrive at the judgment of form adequacy. (Bahr 1973: 65) With regard to the concept of inversion, it must be said that a theoretical practice that gains its object of cognition through the representation of the inverted conceptual manifestations of commodity, money and capital form (whereby it is irrelevant whether reality determines the concepts or the concepts determine reality) and at the same time wants to be immanent critique through this representation, that this very theoretical practice must be able to reveal the inverted reality as inverted, and this step obviously requires an extraordinary or enormous consciousness that succeeds in deciphering the inversion and its underlying value forms in theory in order to describe/deduce the real inversion as such, whereby basically the theoretical operation of deciphering can only be the correct reproduction of the inversion in reality.

In this context, Christine Woesler has accused Bahr of ignoring the qualitative difference between the form of money and the form of thought or theoretical knowledge of nature. Woesler, on the other hand, assumes that at least the difference between real abstraction and thought abstraction, as stated by Sohn-Rethel, even if not explained, is inescapable, since it is impossible for the natural sciences to be completely realized in machinery or technical objects, as reality always contains an inert matter that resists the natural sciences. (Cf. Woesler 1978: 222) In the natural sciences, the laws of mathematics, which do not have to have a concrete object of their own, are related to real phenomena (light, movement, energy,

etc.), and this is done via the experiment, in which apparatus and material-discursive practices are used to select what does or does not correspond to the mathematically formulated law as a phenomenon (instance that consists of the interaction of object and apparatus and produces results qua incisions). In contrast to the qualitative, manually oriented experiment, Christine Woesler mentions the measuring experiment for further clarification, which in her opinion was first developed by Newton. Nevertheless, there is no causal relationship between science and engineering/technology here either, if only because technology also remains dependent on an “inert” matter, from which the natural sciences, which work with the a priori of mathematics, can also abstract to a certain extent (without being able to completely eliminate the abstract). Therefore, according to Woesler, the natural sciences could have emerged historically before machinery. (ibid.: 214) However, Woesler himself runs the risk of concealing the fact that quantum theory always constructs and produces “matter” by materializing mathematics through the use of experimental apparatus. In this respect, the natural scientist has no absolute power over the supposedly passive matter, since on the one hand not every intended result is possible qua experiment, and on the other hand socio-economic processes constantly intervene in the experimental sciences. Conversely, however, the object does not automatically point the way to knowledge. Knowledge and matter are then to be understood as interacting “moments” of social practices that produce materializable phenomena, insofar as the material itself becomes part of the discursive manifestation of meaning. (Cf. Barad 2015: 61) The social practices that exist in the “intraactions” (Barad) between the material and the discursive are objectified in certain technologies that entail real material consequences and can therefore claim objectivity. In general, it can be said that an entanglement of matter and science, as conceived by Karen Barad, for example, aims to turn away from both naïve realist and purely social constructivist positions by showing that the natural sciences do not represent and modulate an independent reality, but rather, in the context of economic-semiotic-discursive, material processes qua mechanical apparatuses, carry out interventions and foldings that have real consequences in the world of capital. However, Woesler points out that with the experiment and as a result of the schematism embodied in it, an already constituted nature is changed. This fact complements the natural sciences and their theoretical-mathematical foundations, the genesis of which Sohn-Rethel had attempted to explore solely in exchange mediated by money. Moreover, Woesler’s thesis should be added that today we must assume that real abstraction and mental abstraction can actually merge in algorithms.

When Bahr speaks of specific forms of thought and knowledge as moments and results of the movement of capital, he is referring to a stage in the development of capital in which mental labour or the “general intellect” has long since become a constitutive part of the production process and has itself already been subjected to mechanization. One must now indeed assume the real subsumption of (industrial) machinery and all labor under monetary capital. Nevertheless, for Bahr the mind remains both a result of economic processes and a subjectivizing-active factor within them. Without the activity of the mind, which produces specific means of cognition, neither the structural use-value form nor technology could emerge. However, the mind itself and its means of cognition were in turn constituted by socio-economic practices. Henryk Grossmann was perhaps a little too hasty in pointing out that the deductive forms of thought were always related to the mechanical-dynamic relations



of the “machine”, insofar as these – as natural-analytical given – provided the content for formal thinking in a sensual way. (Borkenau follows Grossmann and explains the genesis of theoretical mechanics from the division of labor in the manufactory). In a certain sense, for Grossmann the practical mechanical synthesis (as evidence) remains presupposed to the deductive forms of thought. Even Bahr, in his early phase, still speaks of practical mechanical synthesis preceding the deductive form of thought (cf. Bahr 1973: 68), and this should be regarded as a postulate that should lead to the pure, contradiction-free functioning of capitalist production processes. Grossmann, however, negates the fact that even in classical mechanics, which only developed in the 17th century, the direct connection between forms of knowledge and mechanical, uniform production did not yet exist at all.

In his book *Was ist empirische Wahrheit?* (What is empirical truth?), Schlaudt described the connection between deductive forms of thought and mechanics (basic form of the machine) as a parallelism of real genesis and ideal genesis. Real genesis provides the conditions of validity for the deductive forms of thought or scientific knowledge, i.e. the latter remains related to material-symbolic means/machines, and at the same time validity must be established through the performative explanation within a certain field of technically instructed applications. Scientific theories construct and anticipate validity by referring performatively to the world/machinery. The deductive form of thought is intended to scientifically construct a flawless functioning of the machine, and this in turn must entail the transformation of the deductive form of thought into a practical analytics that has to deal with both the malfunctions of complex machines and the invention of new viable models of machines. Deduction and practical-empirical analysis always remain related to each other, insofar as both areas have to fulfill the postulate of the smooth functioning of the machinery, and this refers on the one hand to the factor of regularity, and on the other hand to the practice of certain causality mechanisms, whereby, at least according to Bahr, formal logic anticipated technology at this point. (Bahr 1973: 69) Nevertheless, the technical artifact is definitely not a logical argument. (Cf. Schlaudt 2014a:188) And it should be added that the cognition of objects cannot be reduced in a crude materialist manner to a co-determination of socio-economic conditions and objects/world; rather, the socio-economic conditions determine the (technical) objects and relations in the final instance, because every causality of the relations must be validated by social perception and socio-economic practices (in laboratories, companies, etc.).<sup>5</sup> (Ibid.: 59)

The systematic connection between science and technology only emerged at the beginning of the 20th century, with electronics and the chemical industry. When the scientification of production finally took hold at the beginning of the 20th century, the relationship between knowledge/truth and economics changed. For Marxist theory, the convergence of the two areas is reflected in the premise that here, too, the connection between genesis and validity must be understood, i.e. the sciences and their findings must always already refer to socio-economic facts (already constructed facts) and to the relevance of technical means. (ibid.: 26) This is understandable because all “productions” sui generis involve technological mediation processes that belong to the second nature (the culturally appropriated nature, ibid.: 104). Leaving aside the question of empirical truth, it is precisely natural science and its cognitive processes that naturalize the economy in order to set itself up as an ahistorical, objectively universal and neutral measure and regulator, whereby its unquestioned premises include

abstraction, quantification, nonsensicality, etc. (cf. Woesler 1978). (Cf. Woesler 1978: 218)

According to Woesler, the concept of law in the natural sciences was developed in the 17th century as mathematical rationality and arithmetic, while at the same time the measuring experiment was introduced into the natural sciences as an empirical basis and with it the theory of scientific progress and its usefulness was formulated. (ibid.: 240) The implementation of the a priori concept of law led to the relativization of Hume's concept of law, according to which laws were nothing more than empirically ascertainable regularities. In a certain contrast to Christine Woesler's theses, Schlaudt pointed to the work of Edgar Zilsel, according to whom the scholastic tradition and its symbolizations in their creative connection with the artisan artist were already responsible for the emergence of the modern natural sciences in the 14th century. (Schlaudt 2014a: 125f.) According to the studies of the Austrian Marxist Zilsel, even experimental science can be related to this initial stage of modern natural sciences, which emerged from the synthesis of the affirmation of a (divine) natural law qua symbolic means of representation and the practical, quantitative knowledge of craftsmen and their experimenters. Natural laws here not only have a descriptive but also an explicitly prescriptive dimension, they contain the summary of empirically established regularities. (Ibid.) According to Schlaudt, this says something about the real genesis of the modern natural sciences, to which, however, a theory of ideal genesis must be added, which in turn can serve to reconstruct the real genesis. (ibid.: 295) The a priori character of the modern natural sciences is at least relativized here. The Renaissance craftsmen mentioned by Zilsel (Da Vinci, Cellini, Martini, etc.) are, however, without exception "artist-engineers" whose mathematics has a static form (characterized by the absence of the concept of time) and also remains related to the craft and therefore cannot provide a point of reference for the emergence of industrial production. The attempt to derive the experimental methods of natural science from the combination of scholastic science and craftsmanship must therefore fail.<sup>6</sup>

Woesler, on the other hand, assumes that it was only Newton's description of the measuring experiment – albeit with a number of ambivalences – that halfway succeeded in integrating mathematics (algebra and arithmetic) and empiricism. With the measuring experiment, the mechanical-geometric image of nature is implemented in reality, whereby, if successful, profound incisions are made, the results of which are scientific phenomena. It should be noted that with Newton it was empirical phenomena rather than the mathematical a priori from which the laws of motion were deduced. Woesler assumes three steps with regard to the Newtonian representation of the mathematical laws as facts in the experiment: 1) The isolation of the phenomena by determining the modes of variation. 2) The deduction of the laws of phenomena through the mathematical construction of the modes of variation. 3) The use of induction to enable the applicability of mathematical deduction to further phenomena and to introduce further quantifications for more complex phenomena. Finally, it must be possible to transform the mathematical deduction itself. (Cf. Woesler 1978: 277)

Newton used the inertial system to establish the exact measurement of absolute motion as a condition for the real measurement of motion at any time and in any place, whereby space is assumed to be a homogeneous geometric system. And time is a purely mathematical time, which Newton calculated via the continuity of number. In absolute space and absolute time, the bodies move in their relationships and relations to each other. This transparency of the

measuring process itself is regarded as a criterion of objectivity. This includes the quantification of force, in that the bodies/masses take on the energetic properties of inertia and attraction and thus receive energy. In order to mathematically extrapolate Galileo's law of inertia (there is no force behind the movement, but it is in it as inertia), Newton did not start from velocity, but from acceleration. In the measuring experiment, in contrast to the qualitative experiment, which remains related to manual production, a computational calculation is used to modulate a second nature, which stands in relation to artificial artifacts or means, i.e. measuring apparatuses, which are already removed from sensuality and sensory data (which, as Sellars says, are themselves already theoretical entities). The measuring experiment cannot do without the a priori of practical mechanics and geometry, which make the establishment of constancy possible in the first place. At the same time, the refinement of quantification and measurement methods is always related to innovations in mathematics and mechanics. And this includes the predominance of a syntax of forces that are measured in mechanics using the instrument of the dynamometer, so that a quantitative unit can be condensed in an articulated structure. Quantification is itself the syntactic moment with which elements, results and traces are removed from their concrete temporal rhythms and translated into pure temporality and spatiality. (Cf. Bahr 1983: 171) A real, continuously divisible and mergeable homogeneous space is defined as mathematical space, whereby mathematics and physics meet. It is Euclidean geometry that serves to analyze movement and space, whereby the law of number leads to fixed relations between dynamic quantities. (The exact measurement of movement at every moment is possible with Leibniz's infinitesimal system and Newton's inertial system). And motion is defined by the (measurable) quantities of space and time, whereby the establishment of equilibrium remains the anchor and goal of measurement. It is not the movement of machines that constitutes the mechanical, but rather Euclidean geometry as a form of movement, which is the immovable par excellence, the law. And Bahr summarizes: "Mathematical mechanics is a cold dream of the paradise of order and stability." (ibid.)

According to Woesler, a specific constellation of production and circulation, which can only be that of capital itself, is required in order for the substitution of the primary, practical-sensual relationship to nature, which is essential for modern natural science, by a second relationship to nature, which is generated by measuring and experimental methods, to fully assert itself in the social field of capital. In the abstraction from the material (without eliminating the material), Woesler early on suspects a structural similarity between Newton's inertial system and exchange. The uniform movement of monetary capital through all its metamorphoses (including production) would indicate a further analogy between the natural sciences and economics. (Woesler 1978: 275). The emergence of merchant capital in northern Italy in the 15th century led to the development of double-entry bookkeeping, which is still considered the notation system of the principle of capitalization today. With double-entry bookkeeping, the movement of monetary capital on the capital account can be clearly recorded as a plus or minus. This led to the installation of a system of notation based purely on figures, which not only registered the profits and losses of the individual capitals, but was also able to record them in a temporal format. And Sombart notes: "Double-entry bookkeeping is born of the same spirit as the systems of Galileo and Newton, as well as the teachings of modern physics and chemistry." (quoted from Woesler 1978: 312) Double-entry

bookkeeping and Newton's law of inertia are both characterized by the abstraction from use value. Against positions such as that of Edgar Zilsel, Woesler insists that the measuring-experimental method could not be derived from the craft, from the division of labor in the manufactory or directly from the state of the means of production, but rather that the half-developed circulation of merchant capital and the associated calculation of the calculation were responsible for this. (ibid.: 241) In addition, the absolutist state apparatus played a certain role in the constitution of the scientific experiment, which provides for a specific way of arranging elements and apparatuses that must be constitutive and repeatable for the material-discursive practices. This presupposes observations or prescriptive rules in order to be able to manipulate objects for practical purposes.

For Woesler, the constellation of the measuring experiment in the 17th century, as demonstrated by Newton as an exceptional intellectual phenomenon par excellence, represents in some respects an anticipation of the capitalist structure of production, i.e. the development of machinery. (ibid.: 299) In the 17th century, scientific forms of knowledge or theoretical, experimental knowledge of nature could not yet be directly related to the capitalist production process and the structure of machinery, as we were still dealing with the artisanal or manual mode of production, which was supplemented by long-distance trade, rural publishing and state production facilities. The forms of knowledge were thus more related to the circulation of merchant capital than to the manufactory mode of production, a circulation which, however, already required calculation as an economic principle of action. Woesler also cites various technical utopias that were to be found in the context of state war technologies, architecture and arts and crafts as factors in the implementation of the natural sciences. And the absolutist state should not be forgotten as an organizing factor in scientific research. In the 17th century, therefore, the ways of thinking and methods of calculation were still mainly related to circulation, whereas in the 18th century the expansion of knowledge was linked to the differentiation of trade, the expansion of production for markets and the expansion of money trading and its institutions (stock exchange and banks), and this still under the dominance of circulation over industrial production. Finally, circulation must have become generalized (including the commodity of labour power), merchant capital or agrarian capital must have been transformed into productive capital, that is, both production and circulation must be regulated by the abstract principle of the calculative-quantitative determination of monetary capitalization in order to be able to speak of industrial capital at all. The measurement of the homogeneous movement of monetary capital and its changes corresponds to the measurement of the movement and its change (in the experiment), which is carried out by means of fluxion calculus or infinitesimal calculus. Industrialization was the result and not the precondition of capital, and it was initiated by agrarian or proto-capital. In her book *The Origins of Capitalism*, Ellen Meiksins Wood writes that it was the triad of landlords, capitalist tenants and wage-dependent workers in England in the 16th century that set in motion the laws of motion specific to capitalism: competitive production for exchange value and profit, competitive market dependence, capital accumulation and the compulsion to increase labor productivity (increasing the yield per unit of labor). (Meiksins Wood 2015: 150f.) Meiksins Wood cites the transformation of property relations, the specific logic of production, the size and function of the internal market, the composition of the population and the dimension of international imperial-driven British trade as conditions of opportunity

for capital that were more essential than progressive technologization. (Ibid.:164)

Bahr points out in his essay *The Class Structure of the Machinery. Recognition of the Form of Value*, Bahr points out that natural science in the 20th century adopted the operational pattern of capitalist production processes in the conduct of its experiments: Under an identical technical experimental arrangement and apparatus, and by means of a specific composition of the respective elements, identical results should necessarily be obtained in the measurement procedures to be repeated. The empirical truth of a measurement result is therefore dependent on the accuracy and repeatability of the measurement procedure and thus on the objectivity of the material discursive practice or production. (Cf. Schlaudt 2014a: 80) It will now also be decisive that it is often the technical apparatus itself and no longer the people who measure things. In this way, an object-object relationship is installed that is technically produced and reconstructed, so that the scientific experiment itself becomes the object of its own method. (Cf. Bahr 1970: 37) According to Bahr, the experiment implies the comparison of a nature that has already been empirically experienced, i.e. structured, with a technically rationally understood structure of the experiment, and if this comparison is shown to be an identity, the subject can be excluded from the arrangement of the experiment, from the apparatus and from knowledge. Bahr's remark that the subject only approaches the experimental set-up from the outside, while at the same time nature is to be explained by the subject, remains imprecise. The subject cannot be completely excluded from what Oliver Schlaudt calls the production of empirical truth, but the idea of experimental practice as the result of an omniscient epistemic subject must be replaced by an examination of the historical-material-discursive practices and actions of collectives. Thus, the physical theorem does not refer directly to nature, but rather to nature mediated by technology and material-discursive practices, i.e. to the materialized phenomenon of a nature reduced to form. (cf. Schlaudt 2014a: 221) And even entities (waves or particles) are not inherently determined, but are performed as phenomena in a variety of ways through different given conditions in experiments. (Barad 2015: 101) If Bahr insists at this point that the experiment must be repeated in a person- and situation-invariant manner, whereby the respective technical-experimental test arrangement determines the course of the experiment, the subjective moment still plays a certain role, insofar as a certain course of the experiment is expected or predicted by a research team qua given empirical knowledge. Thus, the object of knowledge also remains the result of a collective construction process, which, however, is not bound to a totalitarian subject of knowledge, but rather to the collective language and semiotics, to the socio-economic rules of the scientific enterprise and its apparatuses and instruments. In this context, Marx's talk of "objective forms of thought" then means that the categories of the natural sciences and the reproduction of scientific phenomena under the conditions of experimental (material-discursive) apparatuses, whose location is the laboratory, always attain their validity in relation to specific socio-economic practices of capital. (Cf. Schlaudt 2014a: 192) The measurements are mediated by specific apparatuses, whereby the respective measurement result can be related back to a regulated handling of the respective measuring apparatuses. At the same time, however, the measurement result can also be interpreted as a forecast of the future behavior of experimental measurements. And the measured value, which Schlaudt calls "Empirem" (ibid.:115), by no means includes the numerical determination of the properties of things, but rather indicates the information about the behavior of an

object in relation to a measuring apparatus and the observer, or, as Schlaudt says, in relation to a stable network of different techniques. A certain effect is to be achieved with given means or apparatuses, and this already includes a residual subjectivizing purposefulness qua observation. With regard to the stable network, the interaction between object and apparatus, Niels Bohr speaks of the phenomenon. He writes: “Accordingly, the unambiguous description of actual quantum phenomena must in principle include the specification of all relevant features of the experimental arrangement.” (Quoted from Barad 2015: 26)

At first glance, Hans-Dieter Bahr’s heteronomous concept of machines, which he outlined in his essay *Umgang mit Maschinen*, does not seem so far removed from Laruelle’s concept of techno-fiction. On the one hand, a (fractured) discourse on the genealogy/archaeology of machines and technical objects, from the trap to baroque slot machines to the industrial robot. On the other hand, an equally displaced genealogy of the concepts of technology and machines and their statements, which in the context of the hegemonic history of science were mostly categorized in philosophical, mechanical, instrumental or anthropological terms and schemes. Bahr, on the other hand, wants to write a non-linear genealogy and archaeology of machine (concepts), one for which, as he says, the de-composition of the concepts of time “now” and “sequence” is necessary in order to escape any meta-historical position, i.e. the widespread view that everything is in time and that the problem of absence does not even exist. (Bahr 1983: 19). What bothers Bahr about the concept of genealogy is the all-too-rigid conception of a law of development that flatly ignores the wastes, distortions, bends and indeterminacies in the a-linear progressions of machine discourses. (ibid.: 270)

To think the machine in its opacity means to understand that discourses and statements about the machine and the “object” machine are not interchangeable, that the reversibility of reality and ideality, which philosophy in particular has always planned for, need not take place. Reversibility here remains an effect in the imaginary (cf. Laruelle 2014: 105), while Bahr wants to be guided in the symbolic by a search for and reading of traces that leads him to an “archaeography of machines” (Bahr 1983: 18), in which the machines and the statements about the machines, if both are superimposed or superimposed without establishing reciprocity, can not only be read or deciphered in their rhythm, but can be amplified or exaggerated in their evidence to such an extent that the prevailing discourses on technology simply have to bend and bend. This actually opens up the space for a new way of thinking about labor that rejects the linear inscription of technological events by showing that the phylogenesis of the machine never proceeded in a straight line, thus raising the question of when and how certain theorems about technology emerge in history; for example, the discourse about the machine, according to which technical objects are projections of bodily, social and cognitive organs and functions, only emerged as a common form of discourse at the end of the 19th century. Thus, the discourse on the machine, according to which technical objects are projections of bodily, social and cognitive organs and functions, only emerged as a common form of discourse at the end of the 19th century, although it was already present in the history of philosophy and technology much earlier.

Bahr’s problems thus have certain affinities with Laruelle’s concept of generic science, who in his book *Non-Photography/Photo-Fiction* criticizes the photographic representation with which philosophy still (re)negotiates the world today by creating a structural connection

between the photographic appearance – objects and the world – and the objects appearing in the photograph plus their discourses, which is displayed in particular as an image, reflection or representation in the mirror labyrinths of the discourses themselves. (Cf. Laruelle 2014: 24) Bahr, in turn, traces this monstrous peculiarity of philosophy to set itself as a reflective a priori back to the light machines, which, in the course of the methods of the Enlightenment – illuminating, looking through and shining through – would have created a reflective projection machine in order to repeatedly produce the image or the correspondence between thing and idea, reality and ideality. (Cf. Bahr 1983: 21) In these discourses, the machine often appears as an intermediate part whose three-dimensional materiality recedes into the background in favor of a (two-dimensional) projection of human knowledge. At the same time, however, the machines should continue to appear as three-dimensional physical projections. (Ibid.: 21) This in turn refers to analyses that have remained virulent to this day, which attempt to link technology to the drive history of the organism or the human will, insofar as technical objects, machines and tools are imagined as mapping and/or extended projections of the body and its biological, psychological and cognitive functions (will), functions that can reinforce the body's spheres of action in certain external technical milieus, while paradoxically describing the body itself metaphorically as a mechanical, instrumental machine. (ibid.: 81) The technical objects are kept available as means in the context of the body's spaces of action, whereby they can also disappear as prostheses in their availability, so that the technical objects are then no longer granted any power to seduce, to change and to exert pressure on the body, and thus, according to the requirements of anthropology, man only ever encounters his own knowledge in the technical. 7 (Ibid.: 94)

However, the discourse on projection soon had to be defined more broadly because the first asymmetries between the body and technical objects quickly emerged within it. The almost serially constructed relations of representation, be it similarities of form (pliers, teeth, etc.), structure (heart/pump) or function (computer/brain), and, once again, the objectification of drive (aggressiveness/war machine) or rational will (rationality/technical systems), led back again and again to the question of the appropriateness of technology (to the body and mind/will). (Ibid.: 82) However, the technical objects continued to be assumed to have a similarity to the body or the will, which was understood as the projection or the process of witnessing and creating tools. However, it is easy to see that even simple tools, such as the cup, do not duplicate the original function – in this case the drawing of water with the hands – but actually dissolve it (the cup is held differently). By and large, the theorem of gestalt similarity would degrade the tool to a statue depicting the human being and his abilities, and in order to avoid this, projection theory had to ascribe to the tool at least the potential to extend, increase and strengthen bodily organs. At the same time, the newly created contexts in which machines are used continue to be abstracted; think, for example, of the machines used in mining, whose existence would be inexplicable solely by reference to manual labor. (ibid.: 96) Ultimately, in order for the body to be considered a depictive projection center at all, it must at least be described as a drive center. As a result, it becomes impossible to continue imagining technical objects as shape-like images or quantitative extensions of the body; instead, they must be seen as the result of generative projections, of the drive or the will and ultimately of the human brain, which means that the only thing that matters is the functional

similarities between the machine and the brain, the projection of brain activity onto the sensory organs and from these onto external nature. If productivity only exists as the transformation of energies and is not the result of a bodily excess of drive (the effect of bodily organs and their functions on external nature), then we can finally presuppose the meta-physical energy of the mind, which has the ability to recreate the duplications, axiomatics and complexities of machines. Only then can philosophy fully enter the discourse on technology! Ultimately, this discourse condensed into the phantasm of the machine as a projection of constructive human intelligence – machine, in contrast to the statuary of the tool, as a construction of forms of movement.<sup>8</sup> (Ibid.:108)

Labour power, if one does not imagine it as an ecstatic, surplus-value-generating labour power as Marx did, can only redirect the energies present in complex systems due to its physical limitations, mainly qua its intelligence, whereby labour power appears less as a productive force than primarily as a reproductive force. (ibid.: 106) The labor force is per se integrated into a network of machines, whereby the machines are conceived as parts of a communicating, labor-sharing body. This presents a socio-economic body that completely overrides projection theory, precisely by short-circuiting the organism with inorganic mechanics and ultimately with machinery as a system, which makes it possible to install labor as pure communicability on a scientific level.

For Bahr, it is therefore first necessary to show that projection theory was very soon dependent on the idea of a non-corporeal projection, be it that of the drive or the will (as a theory of reflexive knowledge it is two-dimensional and as that of corporeal projection it is three-dimensional). If one now imagines the machine as a social body based on the division of labour or as mediality, then the machine must inevitably be integrated into structures of a human activity or gearing, whereby the drive undergoes its final de-subjectification. It should be emphasized that in such a history of technology, which despite all the breaks is still imagined as linear, an eminent regrouping of concepts often took place, even when speaking of the collective subject, which represents the social, or of capital as an automatic subject that subordinates technology, whereby, and this should be pointed out, where the subjugating unity is desired, the god of violence always speaks. (ibid.: 15) The genealogical orientation seems to break down precisely when these discourses are pushed to their limits or to the edges of their evidence. Often, all that remains is anthropological morality, with which a makeshift attempt is made to neutralize technology in relation to humans, whereby morality itself produces indifferent objects, which, however, decompose precisely that morality itself as a Manichean morality, because the machines cannot be seen for whom they are serving.

Following on from the philosophical discourse of projection, Bahr brings the discourse of imitation into play as the next philosophical avatar, according to which the machines are the representation of an original, namely nature and later the social body. These discourses appear either as a regression to the origin or as a progression, the genesis of the origin. And there is a further differentiation: although the imitation is more original than the origin, the archetype is in turn also more original in the creation of the image. (ibid.:145) The discrepancy closes with the assumption that anticipation is memory and memory is anticipation. Technical objects, as Cues saw it, did not imitate sensual nature, but were images of archetypes initiated by the mind. Bahr points out that ultimately most of these representations, which



wander around in the mirror labyrinths of the discursivities of the machine, grant the derivative greater originality than the original. (ibid.: 22) This leads to the distinction between *imago* and *simulacra* used by Lucretius, whereby in the genealogical chain the common structure of archetype and image breaks down step by step, and the mirages/simulacra begin to lead a life of their own, so that every mirror image is already the mirror image of another mirror image.

The discourse of imitation breaks down at the latest when what is supposed to be depicted as a labyrinthine competition, including the strategies and motivations proliferating within it within the social, machinic body, is no longer a fixable structure itself, i.e. when the referent or the archetype becomes blurred. Whether imitation or projection, a social body in which the play of heterogeneous, controversial and conflictual interests is deeply inscribed only partially reveals itself in the machines. On the one hand, this can lead to the objectification of energetic, temporal, spatial and informative forms of traffic (networking), on the other hand to the representation of integrative connections between machine functions and labor power. For Bahr, the newly emerging discourses are the birth of a cheerful or theatrical positivism that takes the machines for granted and frees them from their reference to the origin. However, a theatrical positivism of machines need not prove to be conservative, but rather an experimental (dis)order, a laboratory, even if it is not autonomous in relation to its “cause”, the real, i.e. it is virtually forced into the identity of thinking-within-thinking and the power-of-thinking according to the real. (Laruelle 2014: 101) Bahr constantly speaks here of the textual regrouping of statements with regard to the technical, which inherited the structure of a specific temporality of their own. If one no longer speaks of the machine in the sense of a “*machina ex deo*”, but of “*deus ex machina*”, only then can the *mechane* reappear as cunning, trickery and ambush. Bahr writes: “The paradox of causality, however, is that if it wants to make up all the causes that are supposed to represent the whole of the thing ‘machine’, its production and use would also have to be included in the machine, but in this way the possible whole becomes indeterminate. The machine as things are neither finite nor infinite, but indefinite, and thus their orders are only discursive.” (Bahr 1983: 23) With Laruelle, one can add that the discursive orders point to the indefinite of a techno-fiction, a conceptual non-technology.

Bahr often shows a certain similarity to Deleuze/Guattari’s concept of the machine. If one wants to identify all the causes of machines, it is essential to consider questions about their manufacture/production and their multiple possible uses, i.e. about the chaos-motive universe of the machinic, which in turn keeps every possible whole of the machines indeterminate. And this implicitly introduces the concept of the machine as transmission (transitions and mediations), which for Bahr appears as a discursive strategy, blasting and orientation, and later and more consistently as a stratagem. The capacity for transformation is inherent in the machine as an intermediate link that mediates input and output, and this is less in terms of the conversion of energies through the production of voltage gradients, but rather insofar as it implements a technical matrix and mathematical construction to ensure precise functioning, but precisely this does not exclude the effectiveness of transformation or disruption. (ibid.: 138) At this point, reference should be made to digital sampling machines, to new technologies for accessing and processing media material. This is no longer about the representation or reproduction of the material, its contexts of meaning and its meanings, but

about its transformation and modulation, namely through a technical-methodical principle that allows direct access to the signal of the transmission media, a third aspect of transformation alongside transmitter and receiver, with which the signal contained in the technical channel is cloned and made accessible for transformation. Sampling as a process undermines the targeted transmission from the source to the destination address, as depicted in Shannon's model, for example. At this point, the problem of appropriateness or measure reappears, as does the problem of the disruptive cut in the historical development of technologies, or even the quantum leap, which is about determining when and how a cut was made in the infinite dynamics of indeterminacy and thus the production of a new phenomenon. The example of quantum physics clearly shows that Planck or Bohr really could not have foreseen that the empirically proven uncertainty in the measurement methods and the associated theoretical discoveries (which, among other things, eliminate the separability of object and observer) would one day result in smartphones. Heiner Mühlmann points out that the necessary steps and cuts, such as the invention of the semiconductor, the computer, the Arpanet and the Internet, the miniaturization of computers and the mobile application of the Internet, took place discontinuously and largely unpredictably. (Cf. Mühlmann 2013: 26)

So this is what Bahr is primarily interested in: To describe the machines in their differential neutrality or non-neutral indifference, insofar as they function as non-causal blasting and jumping machines in order to process as the epitome of a new art of disguise beyond the old familiar means-purpose schemes. The coming concept of the machine radically subtracts the philosophical interpretation centered around concepts such as isomorphism, objectification qua natural law or the projection of bodily and social organs. The machines are to be questioned not only with regard to their syntax and pragmatics, but also with regard to their semantics. By looking at the semantics, Bahr suggests an archaeological search for traces, which reads from the machine that it can be based not only on an axiomatic but also on an axiology, a decision by the manufacturer who wants to realize an objective norm with the construction of the machine. (Bahr 1983: 189) Ultimately, it can be the machine itself that prescribes the norms, especially if it is coupled with other machines (telephone, filter, radio, etc.) to form installations or networks of devices/appliances. This would mean that both technocrats and critics of technology would have to see the question of machine choice in a new light (actions beyond the yes/no decision; *ibid.*: 192).

Bahr marks several levels here: First, it is a matter of designating the sensual appearances of technical objects until these appearances finally become carriers of signs, i.e. are given witness status. In order to maintain immanence here, the semantics and pragmatics of technical objects must in turn be supplemented or even replaced by the description of their syntax, whereby methodological principles such as deduction, regulation and ordering procedures become more important in the machine discourses for the first time. (*Ibid.*: 218) The description of technical objects aims (in theoretical mechanics) at the production and guarantee of structural order. And thus, according to Bahr, the effect of the machines and their theoretical representation are congruent. Theoretical mechanics favors the absolute presence of uniform machine movement, which is presented in the concept of time as an infinite present. Uniform motion, which Newton understood as the product of two equalizing changes in speed, is based on the geometry of pure change of position. Here the machine is given movement on the one hand, but on the other hand it cannot go beyond the

transformation of this movement, i.e. it cannot transform the transformation itself. (ibid.: 35)

The question of causality is replaced by the description of the machine as a purely functional order. The production of the machine is now a matter of designing its (mathematical) construction in such a way that it inevitably functions in this way and no other, i.e. the possible is always the ultimately real, entirely in the sense of Hegel, for whom the real already contains its own possibilities and potentialities and also realizes them. (Ibid.:138,103)

In the discourses of mechanics, the writing of the syntax of machines with regard to their smooth functioning remains entirely bound to the binary pattern (static-dynamics, locking mechanisms-drives, etc.). It is about the axiomatization of rest and movement, which is stabilized in favour of rest by capturing the unsettling nature of movement (blasting, flight). (Ibid.: 218) The movement – imagined as explosion, flight, etc. – must be captured, a trap must be set for the trap, and this is the task of theoretical mechanics. If the wheel on the shaft is outwitted, so that the constantly occurring imbalance serves to create a new equilibrium, then the problem of causality can be transformed into the two-dimensional image of pure functioning. This image corresponds to the presence of an absolute presence of all movement or the idea of time as an infinite present. The description of functional ordering processes replaces those machine discourses that still posed the problem of causality, the processes of production and use. Such an assumed pure functionality of the machines must necessarily exclude the relationship of the machines to the economy and to external nature. And this leads to the final axiomatization of the machine, which now dominates most theoretical discourses on the machine within the framework of deductive and constructive mechanical engineering. And thus the various theories about machines disintegrate into axiomatic functionalism on the one hand and the discourses of philosophers, anthropologists, economists etc. on the other, who now celebrate the emergence of the possibility of the reversibility of discourse and technology under their own direction. As can be easily understood, the discourses on the machine have shifted dramatically, especially when the question is no longer about the object “machine” but exclusively about the functions of machine transmissions in the technological sense. Deductive and axiomatized machine descriptions, in which the machines exist as transformers of energy and information, aim at the structuring and taxonomies of the machine elements in order to describe the integral communicability of the machines with each other through their recalibration and recomposition. The aim is to arrive at a general concept of the machine on the basis of exclusively communicative criteria, although it quickly becomes apparent that the general communicability of the machines themselves is only one of their elements (and that others remain excluded). Scientific mechanical engineering defines communicability as the sole criterion that controls and regulates machines. And it seems that the difference between the machine and the economy, the social and the political also disappears, because the machine now proves to be pure neutrality or pure transmission, without having to refer to external points of contact at all.

At this point, Hans-Dieter Bahr notes that cybernetics does not differ significantly from the mechanical machine discourse in terms of control and ordering capacities, be they of an internal or external nature. The construction of a control loop, in which every change in a controlled variable that is considered a deviation is compensated for by a counteracting variable, is preceded by the Newtonian formulation of the equality of effect and counter-

effect. If we speak of cybernetic systems in terms of the fact that as far as possible no (disruptive) human element is involved in their processing and the control, which in contrast to an action appears here only as “behavior”, is essentially reduced to the switching on or off of the machine systems by the human agent, then the anthropological scheme is by no means turned its back on. For one continues to speak of controlling interventions in a control loop, which are perfect interventions precisely when there is no malfunction or accident, which in turn tends to reduce control to the maintenance of a linear, trouble-free process that is supposed to correspond to a steady state, which in each of its moments is the respective distance between binary states, up to the limit value of their coincidence. (Ibid: 194) Bahr assumes that, precisely because cybernetics adheres to the term equilibrium, it is essentially a mechanical theory extended by the processing of order: effects produce counter-effects that present themselves as causes. Cybernetic feedback is about whether the disturbances are compensated by the machine complexes automatically or externally through human input. The human switching element is still present, the instrumental organon that prevents the automaton from becoming a pure perpetual motion machine, at least when set values are entered, even if it is a one-off programming. In the cybernetic discourse, the self-regulating automaton thus remains bound to the coupling of machines and humans, whereby human decision-making and control follow a logified structure of either/or, the yes/no decision, and therefore excludes the admission of infinitesimal difference.

When the machine finally mutates into an information machine, i.e. when it already informs other machines, then the machines are definitely located in technical environments, in contexts with other machines, in networks, in machine associations and the corresponding procedures and rules, as Simondon, for example, indicated with the concept of the filiation of technical objects. The cybernetic or system-theoretical discourses on the machine open up a theoretical scope that goes beyond the above and makes it possible to describe the machine as a discursive formation (and not just as a purely internal network or only as a functionality or object). Of course, the discursivity of machines includes their communicability (initially through mathematical, technical instructions and procedures), whereby machines today must increasingly have the capacity for procedural plurality, i.e. they must enter into a field of possible communications whose procedures appear less as caused and more as strategically motivated by capital. The more economically complex the financing of machines becomes, the more the plurality of machine processes is required. And therein insists the question of how work sans phrase can be transposed into possible work, to which Marx responded with technique and technology, which step into the intervals of insufficiency of work (cf. Lenger 2003: 157), which is quite obviously about the transposition and replacement of work itself. With increasing economic costs incurred in the production of machines, the need to take factors such as process plurality and speed into account is therefore growing, with machines now being formulated more strongly in the context of their potentialization. Complex new machine environments are emerging in which the machine processes are not only processed through information of a technical nature, but also of an economic, social, biological and political nature, and at the same time endure or persist through factors such as accidents, disruptions, shifts, displacements and surprises. Information, which expresses the potential of the possible, is also transformed, when it is subjected to capitalization, into power-related communication, which today includes the filtering and industrialization of data and

information. Technology is thus inevitably related to machine concatenations, their systems and networks, to operations, functions and procedures, to axiomatics and rules, indeed to the entirety of machine conjunctions. The concept of the thing has thus been definitively dissolved, and the fixation of the machine on a single process or a single speed is also being given less and less consideration. Thus the empiricism of machines is finally integrated into the field of communicative potentialities, and this leads Bahr to the concept of strategy, i.e. the option or choice of a certain 'machine procedure. All machine discourses, be they those of production, information, transportation, energy and human technologies, now refer to the ecology of machines or to their networks, which are presented as parts of specific environments. Information is always accompanied by processes of absorption and filtering, in which data and information are selected and redistributed by economic-power-oriented processes.

Obviously, the machine can only be described as a discursive formation. (Cf. Bahr 1983: 277) The characteristics of the machines and their constructive form determinations continue to be characterized by a certain differential diversity and a certain susceptibility to disturbances, beyond the rule-based communicability. (ibid.: 230f.) With regard to the finality of the machines (means-to-purpose), it is also important to consider the difference, for example the difference between technical feasibility and economic profitability with regard to the production and use of machines. The unification of effects, which follows the systemically necessary production of efficiency, cannot completely eliminate the chance that is involved in the interlinking of the mechanical, but can only offer guidelines for its taming or avoidance. Nevertheless, the maxim should somehow persist that everything ontic consists in coming into being and passing away, while only the object itself endures, namely as logos. (Ibid.: 33) Finally, the content must correspond to the form of the statement, because otherwise the ontic as a coming into being and passing away would get lost in bad infinity instead of being held together by the cause, which is continuity. However, if machines are defined primarily in terms of the functioning of their functions, then they constantly produce new conjunctions, and so a variety of functions inevitably emerge, which can be identified, among other things, as disturbances or side effects. Machine function here does not in any way refer to an isolated empirical entity "machine", because the functions produce further multiplications and radiations of the functions, new conjunctions, for example the integration of the automobile machine into the more comprehensive transport system. The primary machine function, the functionality of the automobile machine, is clearly dominated here by the apparently secondary functionality of the transport system, which in turn requires complex machine systems to control and monitor it.<sup>9</sup>

In order to gain an even deeper insight into the duplication of machine functions, Bahr now asks what could disrupt the functions of the machine systems, indeed what could actually cause the machines to break down. It has already been mentioned several times that a machine can become obsolete without having to disintegrate as material, namely when its use is no longer profitable for individual capital for economic reasons, i.e. when its contribution is no longer sufficient for individual capital to realize at least an average profit in differential accumulation or to beat other individual capitals. Factors such as idle times, strikes, changes of ownership or mergers also influence the regulated functioning of the machines.

Systems theory conceptualizes the machine-functioning system as the sum of its inputs and outputs. Its inputs include money, algorithms, programs, statistics, knowledge, control, industrial standards, maintenance, energy, various materials, locations, interlinking with other technical systems, wear and tear and climate, while its outputs include changed materials, products, orders, money, times and changes in space. In order to simplify these complexities, the technicist discourse reduces the inputs to human control and work, to software programs and means of production, and the outputs to material products or new machine states. Assuming these reductions, all other inputs and outputs can be defined as inappropriate functions, from worker errors and programming errors to adversities such as climate catastrophes and economic crises. However, insofar as the machine systems are also supposed to absorb these factors as inputs, their functioning must at the same time produce a specific information of the outputs, which in turn contain not only utility values and stable products, but also dysfunctions or waste. If economic operating times, losses and waste are among the inputs and outputs of the machines, it immediately becomes clear that in an orderly feedback mechanism, the inputs must be selected, sorted, some of them preferred and others avoided, so that there is no “bad” information of the outputs, which then appear not as use values but as dysfunctionalities, especially if the outputs are supposed to be inputs into the system again; in order for the machinery to function smoothly, the outputs must be fed back to the inputs in such a way that disruptive inputs are eliminated as far as possible. Thus, cybernetics is primarily not to be understood as automation, but above all as a mechanism of input selection.

In his essay *Black Box, Black Block*, Alexander Galloway points out that the black box has undergone a drastic change in meaning in the course of the hegemonization of cybernetics, namely from a cipher that needs to be decoded or uncovered to a function that is defined exclusively by its inputs and outputs. (Galloway 2011: 273) As a result, Marx's critique of fetishism, which seeks to discover the rational core beneath the mystical shell, has also become obsolete; we are now dealing with a rational/rational surface of machines (interfaces, keyboards, windows, tabs, etc.) and a largely invisible black box. These new black boxes are purely geared towards functioning (computers, codes, protocols, data objects, etc.), insofar as they are intended to ensure the smooth flow of inputs and outputs through programming. As techniques of obfuscation, the black boxes provide a flawless syntax of the surfaces, but leave the inside of the machines largely invisible. Galloway summarizes: “These black boxes possess a purely functional being without essence or transcendental core.” (ibid.: 274) Teleological attributions dissolve completely in this context because there is neither a collective subject called society nor can capital be assigned subject status.

Inputs and outputs, defined as poles, and the machine, defined as the mediation or transmission of the poles, all indicate for Bahr that the machinic relations must ultimately disintegrate into a plurality of transmissions, whereby the poles in the end at best still indicate orientations, incisions and intersections, which Bahr summarizes under the term “stratagem”. With this radical reorientation of discourse, the previous machine discourses are not completely eliminated, but rather reduced to pure material, similar to Laruelle. In general, Bahr calls for a different approach to the machines when he speaks of the stratagems as effects of “the experimental per se, as trial and becoming-trial” (Bahr 1983: 297), and this neither in an infinite nor in a finite, but in an indefinite field, a “campus indefinitum”. At this point, Bahr also

calls for an “archaeography” that confronts the problem of the “overly clear, the indistinct, the allusion and the over-interpretation” (ibid.: 301) in order to escape the philosophical circle of depiction, reflection and representation between reality and discourse. Bahr’s labyrinth of monuments, the manifoldness of temporal functions, can also be brought here into a certain theoretical proximity to Laruelle’s fractal indeterminacy, which of its own accord makes the given irregular at once, in the campus indefinitum according to the real. (Laruelle 2014: 115) However, this force must not sink into complete indeterminacy, but must remain immanently related to the One, i.e. it remains dependent on the Real, which is its immanent cause. This force must identify itself with the real, while the real neither mixes with it nor disappears or merges into it. In a certain sense, this destroys the ideal of the smooth functioning of machines, so that machinic precision can at best still be understood as a problematic complexion, insofar as the machines already have to incorporate other functions, factors, parameters and variables of their field. The machine as a model of precision must definitely evaporate or at least be transformed into a stratagem of degrees of precision, whereby the machine becomes at least a machine of probability. And mechanical engineering must rise to this challenge in order to define the machine not only in terms of its regulated and smoothest possible functioning, but also in terms of its contaminations and distortions in specific economic, social and political areas of use. This means that the affirmative discourse, which blatantly continues to propagate linear technical progress, is finally reaching its limits.<sup>10</sup>

1 One important industry that Marx hardly mentions, but somehow already had in mind, was the electricity industry. In a letter to Engels, Marx expresses his interest in the transmission of electrical power over long distances via telegraph wire, which can be seen as the basis for electrification. (Cf. Heinrich 2011: 188)

2 Bahr points out that Marx often conflates the concepts of “use value” and “product as a carrier of value”, but this also presupposes separation, i.e. they are distinct in the production process and are simultaneously combined in it (the use value of labor power and the machine). (Bahr 1973: 60) Furthermore, it should be pointed out that it does not make much sense to associate use value with the qualitative and the uncountable and, complementarily, exchange value with quantification alone. Climate science shows how attempts are made to quantify imaginary values that are more likely to be attributed to use value. Or, to put it another way, the “qualities” of exchange values should be problematized here and not just their mathematics. Conversely, use value has long been subject to a peculiar parergonal structuring that makes it a signified material that is consumed in and as an ambience according to a differential order. (Cf. Baudrillard 2015: 218)

3 As with the investigation of the structure of the commodity’s use value, Marxist theory has also paid little attention to the analysis of the use value of machines, or more precisely their specific technical form or structure. Some Marxists, like engineers, still view technology in purely instrumental terms – but as a pure instrument it would not be bound to specific purposes and would therefore quickly degenerate into a merely aesthetic object. After all, what matters with such an instrument is either the functioning itself, or an aestheticizing critique of its functioning, which usually consists of adding a further functioning to the functioning.

4 For certain Marxists, the equation of different quantities refers to the third, which is

supposed to be a quantity measured in time: abstract labor time, liquid price form. There could therefore be a third thing that makes the measures comparable. (MEW 23: 73). Here, however, the measure of value is given for a measure of time, which we want to avoid as far as possible. However, we cannot continue this discussion here.

5 Formal-logical thinking is by no means identical with the knowledge of natural science, for the latter contains not only the general categories such as quantity, space, time, motion, mass, atom, etc., but also a multitude of other categories, descriptions, prescriptions and concepts. And both abstracting thought, its propositional systems and formalizations as well as the natural sciences are to be placed in a specific adequation to the capital machines.

6 Sohn-Rethel is concerned with questioning the a priori-mathematical natural sciences with regard to their genesis without, as Woesler points out, analyzing the problem of the experiment more precisely. Woesler writes: "It is true that the experiment is subordinate to the theoretical-mathematical a priori, because the experimental test arrangement is arranged according to the construction principle of the ideal a priori; on the other hand, matter does not find its way into science in the experiment as something merely conceived, but as real nature." (Woesler 1978: 240)

7 This projection proves to be the basic structure of working, i.e. of producing and witnessing, which aims to make something human-like appear in the objects, whereby they become "stuff" in the sense of their materiality on the one hand and witnesses in the sense of messages to be deciphered on the other.

8 For Bahr, Eros occupies an important place in the early machine discourses. If Eros did not yet know the distinction between drive and being driven, it was his restlessness that remained stable, and in order to calm it down and at the same time make it productive, a striving had to be introduced into desire that made the restlessness permanently generative. This erotic machine – engine, indistinguishably driving and driven – always wants to surpass itself in order to simultaneously calm itself in its striving, and the purpose or telos serves this purpose. With it, desire is directed towards production and at the same time integrated into the telos, which leads to the short-circuiting of need and satisfaction. The restlessness of desire is completely subordinated to the purpose, which in turn has to be served by specific means of production and communication. Production ultimately aims to preserve life beyond the death of the subject, at least as a species. Bahr sees the equation, indeed the subordination of production to reproduction, as one of the fundamental topoi of Western reason – and in this sense, economics and technology theory should be understood as the sciences of the immortality of the human species. It is worth discussing how exactly capital machines fail to achieve this goal today.

9 In modern vehicles, the number of functions controlled by ECUs has increased dramatically. Today's automobiles are machines that push towards self-motion through exchange, communication, connectivity and the processuality of data flows. Although the driver is still given the feeling of sovereign control, all components, be they machines, people or social traffic, are increasingly regulated within the framework of machine tracking. In addition, the automobile is threaded into wide-ranging machine and traffic systems, the functioning of which is not due to any engineer, no matter how ingenious, and the quintessence of which



are the freeways and their network, which – as the author collective Tiqqun (Tiqqun 2012) writes in agreement with Hans-Dieter Bahr – allows those being controlled to glide to their destination with a calculated and signaled uniformity.

10 The thwarting of the ideal of precision can be seen in the complexity of machines, in the fact that machines can generate unpredictable effects, which means that they can only be controlled as a means of production by permanently taking the improbable into account. (Bahr 1983: 307) Bahr gives the following example at this point: Take a machine that consists of 1000 individual parts and functions with a degree of precision of 1:100000. If one individual part fails in a series of 1000 machines produced, it can still be said that the machines function smoothly. However, if you transfer this error quotient to complex machines that consist of 100,000 individual parts, for example, the probability that they will not work is very high. Bahr goes on to point out that the malfunction can no longer be remedied simply by increasing the degree of precision, but only by multiplying functions in such a way that if certain functions fail, other functions have to take over, which in turn requires the production of specific bridging functions. (ibid.: 308). Furthermore, this type of stabilization aims at the production of the machine's insight into itself, its capacity to produce appropriate corrections itself, up to its ability to determine the location of the malfunction in its system in order to finally initiate the appropriate repairs.

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